CLAIMS

1. An electrostatic actuator formed in a single layer comprising:

a stator formed in the layer comprising a first plurality of fingers;

a rotor formed in the layer comprising a second plurality of fingers, wherein:

one or more of the fingers of the second plurality is between the fingers of the first plurality, and

one or more fingers of the stator and rotor are positioned above a conducting plane having the same potential as the rotor, and

one or more fingers of the rotor has a height less than or equal to one or more fingers of the stator such that a vertical force is exerted upon the rotor, the height measured from the bottom of the finger to the top of the finger.

2. The electrostatic actuator of claim 1 wherein the single layer is a single layer of a wafer, the single layer comprising a semiconducting material.

3. The electrostatic actuator of claim 1 wherein the single layer comprises a conductive material.

4. The electrostatic actuator of claim 1 wherein the single layer comprises an insulating material.

5. The electrostatic actuator of claim 1 wherein the rotor further comprises a central portion, the central portion forming part of a micro-optical component.

6. The electrostatic actuator of claim 5 wherein the micro-optical component has one or more filter elements, and wherein one or more of the second plurality of fingers moves one or more of the filter elements.

7. The electrostatic actuator of claim 5 wherein the micro-optical component attenuates or switches an input signal by rotation of the central portion of the rotor.

8. The electrostatic actuator of claim 1, wherein a positive vertical force is exerted upon one or more of the rotor fingers such that the rotor is vertically moved from the plane of the stator.

9. The electrostatic actuator of claim 5 wherein a positive vertical force is exerted upon one or more of the rotor fingers causing the central portion of the rotor to rotate about an axis.

10. The electrostatic actuator of claim 5, wherein a positive vertical force is exerted upon one or more of the rotor fingers and a negative vertical force is exerted upon one or more of the rotor fingers such that the central portion of the rotor is rotated about an axis.

11. The electrostatic actuator of claim 5 further comprising one or more springs formed in the layer, the springs connected to the central portion of the rotor.

12. The electrostatic actuator of claim 10, wherein the central portion of the rotor is rotated about an axis aligned with the springs.

13. The electrostatic actuator of claim 1, wherein the conductive plane is located below the fingers at a first side of the actuator, but not below the fingers at a second side of the actuator.

14. The electrostatic actuator of claim 13, wherein a positive force is created at the first side and a negative force is created at the second side.

15. The electrostatic actuator of claim 14, wherein the actuator pivots about an axis located between the first and second side of the actuator.

16. The electrostatic actuator of claim 1, wherein the layer comprises silicon, and the rotor and stator comprise the silicon.

17. The electrostatic actuator of claim 1 further comprising an insulating layer below the silicon layer.

18. The electrostatic actuator of claim 17 wherein the fingers of the stator and rotor are formed within the silicon layer by etching the silicon layer and the insulating layer.

19. The electrostatic actuator of claim 13 wherein the insulating layer is silicon dioxide.

20. The electrostatic actuator of claim 13 further comprising a silicon layer below the insulating layer, and wherein the fingers of the stator further comprise the insulating layer sandwiched between the silicon layer above and below the insulating layer.

21. A method of forming an electrostatic actuator in a wafer comprising a silicon substrate, an insulating layer on the substrate, and a silicon layer having a height x on the insulating layer, the method comprising:

etching a trench having a depth y within the silicon layer; and thereafter

etching the silicon layer and the trench to the insulating layer to form a rotor finger of height x-y and a plurality of stator fingers of height x; and

etching a portion of the insulating layer below the rotor and the stator fingers.

22. The method of claim 21 further comprising depositing a photoresist layer within the trench yet narrower than the trench prior to etching the silicon.

23. The method of claim 23 further comprising etching the silicon substrate from the bottom of the wafer to form a central portion of the rotor.

24. The method of claim 23 further comprising etching a portion of the insulating layer to form a central portion of the rotor.

25. The method of claim 23 further comprising depositing a reflective coating upon the central portion of the rotor.

26. The method of claim 21, wherein the insulating layer comprises silicon dioxide.

27. An electrostatic actuator formed in a wafer having a first conductive layer, a second conductive layer and an insulating layer between the first and second conductive layers, the actuator comprising:

a stator comprising a first plurality of fingers, the fingers comprising a top conductor formed in the first conductive layer, a bottom conductor formed in the second conductive layer, and an insulator formed in the insulating layer;

a rotor comprising a second plurality of fingers, the rotor formed in the second conductive layer, and wherein:

one or more of the fingers of the second plurality is between the fingers of the first plurality, and

when a voltage is applied to the conductors of the stator a vertical force is exerted upon one or more fingers of the rotor.

28. The actuator of claim 27 wherein the second plurality of fingers is coplanar with the bottom conductor of the first plurality of fingers.

29. The actuator of claim 27 wherein the rotor further comprises a central portion that is moved by the vertical force.

30. The actuator of claim 29, wherein the central portion is rotated about an axis.

31. The actuator of claim 29, wherein the central portion is moved substantially vertically from the substrate.

32. The actuator of claim 27 wherein the force moves a filter element of a tunable filter.

33. The actuator of claim 27 wherein the force rotates a reflective element to direct an input beam.

34. An electrostatic actuator formed in a insulating layer, the actuator comprising:

a stator comprising a first plurality of fingers having an insulating portion formed in the insulating layer, and a conductive portion upon the insulating portion;

a rotor comprising a second plurality of fingers, the rotor formed in the insulating layer, and wherein:

one or more of the fingers of the second plurality is between the fingers of the first plurality, and

when a voltage is applied to the conductive portions of the stator fingers a vertical force is exerted upon one or more fingers of the rotor.

35. The electrostatic actuator of claim 34 wherein the insulating portion of the stator is coplanar with the rotor when the voltage is not applied to the stator.

36. The electrostatic actuator of claim 34 wherein when the voltage is applied the vertical force moves the rotor such that it is coplanar with the conductive portions.

37. The electrostatic actuator of claim 36, wherein the rotor movement pivots a micro-optical component connected to the rotor.

38. The electrostatic actuator of claim 37, wherein the rotor movement pivots a mirror.

39. The electrostatic actuator of claim 37, wherein the micro-optical component is a tunable filter.

40. An MEMS actuator comprising:

a stator having a plurality of fingers comprising an insulating material, and a conductive material upon the insulating material;

a rotor having a plurality of fingers consisting of an insulating material, and wherein:

the fingers of the rotor are inter-digital with the fingers of the stator, and

the insulating material of the stator is coplanar with the insulating material of the rotor when no voltage is applied, and

when a voltage is applied to the conductive material of the stator, a force is created moving the rotor upward towards the conductive material of the stator.

41. The MEMS actuator of claim 40, wherein the insulating material of the rotor and the stator are formed within the same layer of a wafer.

42. The MEMS actuator of claim 40, wherein the insulating material of the rotor and stator are formed from different wafers.